ASSESSMENT
OF THE CURRENT SITUATION
IN THE SYR DARYA BASIN
WATER RESOURCES USE

Prepared by:
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Central Asia Mission
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Environmental Policy and Institutional Strengthening Indefinite Quantity Contract (EPIQ)
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Content

I. Introduction.
The Underlying Data: The Nature Management Conditions. Operation Of The Naryn-Syrdarya Cascade In Accordance With The Project - Up To 1987 Inclusive

The present Explanatory Note as to the assessment of the current situation in the Syr Darya Basin water and power resources use has been prepared in conformity with the Decision of the Meeting of the Coordination Group on Modeling the Operation Modes of the Naryn - Syrdarya Reservoirs Cascade held in Almaty on March 10-12, 1999 (Protocol # 2) at which there was underlined the need for assessing the state of the Syr Darya Basin resources use for the last few years: 1995-1998.

The Syr Darya Basin is a part of the Aral Sea Basin, and it occupies the territory of 484.5 thous. km^2. The river flow is principally formed in the mountain area (the upper course), the middle course is in the steppe region which in the lower course gives way to the Kzylkum Desert. At present (since 1991) four sovereign states are located on this territory: the Kyrgyz Republic and the Republics of Uzbekistan, Tajikistan and Kazakhstan.

The general peculiarity of the Basin's climate is the extreme continentality with distinctive great temperature deviation amplitudes during the daily and annual cycles as well as the sharply defined periodicity of atmospheric precipitation being obviously deficient for the farming agriculture, while there are great reserves of the thermal power resources and fertile lands. Everything put together has motivated the development and wide use of the artificial irrigation in the Central Asian rivers' valleys. That is the reason why the water being the most important component of the natural complex has given origin to one of the most ancient civilizations based on the irrigated agriculture, whereas the folk wisdom personifies the water with the life in itself. The Syr Darya River is one of two great rivers of the region in the Basin of which over 20 million people reside, and the river water ensures the people's existence and development for many centuries.

The Syr Darya River is formed by the confluence of the Naryn and Karadarya Rivers in the eastern part of the Fergana Valley, and it is 2,337 km length. The Syr Darya water resources amount to 40.6 km^3, and among this volume 37.12 km^3 - the surface inflow, the part of the underground inflow is 2.18 km^3, and the atmospheric precipitation runoff is 1.30 km^3. The Basin's surface water resources with 5% dependable water supply amount to 54.1 km^3, 75% - 31.9 km^3, 90% - 27.81 km3, and, finally, 95% dependable water supply comprises 21.4 km^3. In this case, it should be noted that about 37.9 km^3 of the water resources are in the area from the sources of the River to the Chardara reservoir. The Basin's main water resources come with the surface inflow from the mountain area (over 60%).

The most complete and efficient way of using the river flow to meet the economic requirements is the flow regulation, for which purpose the reservoirs are constructed on the rivers. The flow regulation by the reservoirs involves the stream volume and flow redistribution with time according to the demands of the water

consumers and water users that allows (to the maximum possible degree) to eliminate inconsistencies between the spontaneous variations of the water content in the rivers and demands of business activities. While creating a possibility for the most complete and effective use of the natural water resources, the river flow regulation makes it possible to solve two main problems: to increase the water content in the rivers during the low-flow periods and to decrease the elevation of high waters and floods. Thus, the specified and higher minimum water discharge is guaranteed than at the natural flow regime.

The flows of the Naryn, Karadarya, Chirchik and Syr Darya Rivers in the area from the Toktogul reservoir to the Chardara reservoir with the total length about 1,000 km are regulated by the Naryn-Syrdarya Cascade managed by the Basin Water Management Organization - BVO Syr Darya. There are five most important reservoirs in the Cascade: three upper reservoirs with the over-year regulation : the Toktogul reservoir (the designed total volume is 19.5 km^3), the Charvak reservoir (2.0 km^3), the Andizhan reservoir (1.9 km^3), and also two channel reservoirs with the seasonal regulation: the Kairakkum reservoir (4.03 km^3) and Chardara reservoir 5.7 km^3). At present the aggregate active storage capacity of the Cascade's reservoirs amounts to 24.1 km^3. In addition, there are a lot of reservoirs on the small rivers ensuring the seasonal regulation of the river flow. The degree of the Syr Darya flow regulation was very high - up to 0.93. It should be also noted that in the river basin there are located 9 principal hydroelectric power plants with the aggregate installed capacity 3,720 thous. kW.

The water resources distribution is performed through the use of large hydrosystems, headworks and inter-republican canals. The most part of the reservoirs, hydrosystems and other hydraulic facilities were constructed in the course of ten-year periods of the 20-th century: in the 30-ties - 70-ties. This made it possible to ensure the water supply for the largest water consumers of the region and, first of all, for the agrarian sector. Owing to it, during the thirty-years period prior to the USSR dissolution the agricultural production increased by 2.5 times that provided a possibility to give work to a considerable part of the increasing rural population which constitutes over 60% of all people residing in the Syr Darya Basin.

The major water consumers of the Basin are as follows: about 92% of the water is used for the irrigation needs, from 3.5 to 4% - domestic water, drinking water and municipal water supply, 2% - industrial and process water supply, 1.5% - agricultural water supply, and the rest falls on the other water consumers including the fish industry.

The principles for the Syr Darya flow regulation involve the following:

- the operation modes of the reservoirs on the small rivers are isolated for each river with separation of the areas having dependable water supply through the river flow;

- the water demands for the Charvak and Andizhan reservoirs are assumed to be the regular one due to a possibility of the return waters various use within the irrigated area commanded by the reservoir;

- the system of three reservoirs located directly on the Syr Darya River channel (the Toktogul, Kairakkum and Chardara reservoirs) being sequentially positioned in a stepwise manner along the watercourse is actually the reservoirs' cascade itself where the difference in time for the high flow in various parts of the Syr Darya Basin predetermines the advisability in the flow compensated regulation through the intersystem water transfer. By this is meant that primarily the water consumers demands are met at the expense of the lateral inflow, and the channel Kairakkum reservoir serves for increasing the water content in the middle course only in case when the water deficit still remains which is covered on account of the compensating releases from the Toktogul reservoir. Such approach was stipulated by the project and was applied till the end of the 80-ties, and as a consequence of this there was ensured the high degree of the Syr Darya flow regulation that was vitally necessary in case of complete depletion of the water resources in the Basin.

The benefits of applying irrigation - the largest initial water consumer in the Basin -

lie in the fact that the dynamics of the water user demands ideally coincide with the hydrologic conditions of the rivers the flood of which falls on the growing season. However during the last century, in the context of development of the region, there appeared other water consumers and water users; in the first place there should be mentioned the rapid growth of the population, construction of large cities and settlements, development of the industry, and construction of the hydroelectric power plants. The availability of many water resources' consumers having diversified interests inevitably give rise to conflict situations, and it is urgent to find a mutually acceptable solution.

A distinguishing feature of the water management in the given region is a complex character while using the water resources. The major water consumer is the irrigated agriculture - over 90% of the aggregate volume of the water used. In parallel with the irrigation, the equivalent component of the water management sector in the Central Asia is considered to be the hydropower sector, and as a consequence of it all major hydrosystems in the Syr Darya Basin are constructed as the complex ones. The rational coordination of contradictory interests of the irrigation and hydropower sectors consisting in various demands concerning the river flow use depending upon the seasons of the year is the important component of the Basin's water resources management system.

The most commonly encountered contradiction clearly displayed in the Syr Darya Basin resides in the fact that the major part of the region water resources is formed in the upper reaches, and there prevail the interests of the water consumers using the power potential of the water, that is, the major consumption of the water resources takes place during the winter period while the irrigated areas are located downstream and the water is needed for them in summer. The Syr Darya Basin is clearly divided into two characteristic parts (regions). The first of them is the upper part or the mountain region (mainly, the entire Naryn River and the upper reaches of the Karadarya River) of the flow formation where is practically no irrigation diversions; the second part of the Basin is the valley area (the Syr Darya channel of its own) where the major irrigated areas are situated and the water diversions prevail over the lateral inflow. The landscape specific character of the region predetermines the

concentration of potential water and power resources and principal location of the HPPs in the mountain area (as to the Naryn River they all are within the boundaries of Kyrgyzstan). On the contrary, the irrigated areas are grouped in the valley region, and mainly they are in Uzbekistan and Kazakhstan, and by virtue of this the interindustry contradictions in the requirements as to the reservoirs' cascade operation mode are as though automatically transformed into the intergovernmental contradictions (since 1991). But the resources sharing is always connected with the proper assignment of priorities and with compensation of potential losses to the industries not receiving the water in the required volumes. A reasonably reliable mechanism for compensations was developed and kept in the Soviet Union before 1991; in this case the foundation of this approach in tackling the problem was the fact that in the Central Asia the most part of population is engaged in agriculture and therefore the advantage in using the river waters was given to the irrigated agriculture, whereas during the autumn-winter period the demands of the upper reaches region in the electric power were compensated by delivery of the heat and power resources. In so doing, the mechanism for compensating the resources was perfectly elaborated. After the Soviet Union dissolution the specified contradiction has greatly aggravated acquiring character of the intergovernmental and interdepartmental opposition. Basically, the above mentioned referred to the operation mode of the Toktogul hydrosystem with the HPP and of the reservoir being the largest one in the Syr Darya Basin and in the whole Central Asia.

After dissolution of the Soviet Union and formation in the Central Asia of five independent states, the water resources sharing in the Aral Sea Basin is managed by the Interstate Coordination Water Commission (ICWC) that approves the limits for the water diversions for each country-the water user based upon the provisions recorded in the Interstate Agreement on Using the Water Resources in the Aral Sea Basin of February 18, 1992 (Almaty City) concerning that the ICWC is charged with «the development and approval of the limits for yearly water consumption for each of the States by the water sources as well as for the Central Asian region as a whole, development and approval of the plans as to the operation modes of large reservoirs, adjustment of the limits and refinement of the plans in line with the actual water content and developed water management situation». Therewith the water delivery quotas are specified separately for the Aral Sea and the Aral Sea coastal region. For the first time the quota values were specified at the ICWC meeting in Ashgabad on April 6, 1992. In this case by common consent of all ICWC members, the actual water diversion rates were taken as the basis by every Central Asian State developed in the course of the five-year period preceding the meeting. The BVO Syr Darya as the executive organ takes as a guiding principle the approved water diversion quotas by the Syr Darya River as well as the approved by the ICWC rates for the Syr Darya water delivery to the Aral Sea and the Aral Sea coastal region. The water diversion quotas adopted in Ashgabad remain practically unaltered until the present time - for the years with the average annual flow, and only during the low-water years these rates are subject to adjustment. The water supply to the Aral Sea and the Aral Sea coastal region depends upon the water resources available and upon the operation mode of the Naryn -Syrdarya Reservoirs Cascade being also approved by the ICWC.

BVO Syr Darya manages the water supply in the Syr Darya Basin to the sovereign States - the ICWC members, operates the diversion facilities and executes the actions for improving the environment and quality control over the applied water resources. The BVO monitors the flow regime of the Naryn, Karadarya and Chirchik Rivers and the Syr Darya River itself up to the Chardara reservoir.

Considering that the change in the Syr Darya water resources use during the last years is related to the operation mode of the Toktogul reservoir, we shall dwell on this problem in greater detail. By the Project, the major purpose of the Toktogul reservoir is the provision of the annual flow regulation of the Naryn and Syr Darya Rivers with the object to increase the water availability for the irrigated lands on the area of 918 thous. ha as well as the power generation in the volume of 4.1 billion kWh per year. The hydroscheme was constructed due to the efforts and financial resources of the whole Soviet Union and was commissioned in 1974 being the powerful complex of up-to-date hydraulic structures.

By the Project there were developed the principles of the present-day water use in the Syr Darya Basin and stipulated the provisions that the Toktogul reservoir operation should be based on the condition of providing the dependable water delivery to the Republics - water consumers in the agreed water diversion volumes from the Syr Darya River channel which could allow to get the stable yield of the cultivated crops. This meant that three quarters of the annual volume of the reservoir releases were performed during the growing season (9.43 km^3). Being on the whole subject to the irrigation regime in the water use, during the intervegetation period the Toktogul reservoir should release no more than 180 m^3/s (2.85 km^3 during the total period) which corresponds to the minimum power generation of the HPP. Along with it, the irrigation regime with provision for supporting the maximum storage volumes and consequently the elevation of the water in the reservoir ensures the largest power output of the installed capacities not only for a separate year but, that is the most important, for the whole period of sequence of high-water and low-water years. At fulfilling the project regulations, there is established such regime of the river flow and sanitary releases that to the maximum degree is similar to the natural regime, and this not only makes it possible to maintain the sustainable surrounding environment but it sets up conditions for supporting the required ameliorative regime of the adjacent to the river territories.

The electric power not generated in winter was compensated through the mentioned above delivery of the heat resources from Russia, Kazakhstan and Uzbekistan in order to load the thermal power plants of Kyrgyzstan as well as through transfer of energy in the electric power grid of the Central Asia. In summer, in case of maximum releases from the reservoir at the cost of the power generation by the Toktogul HPP a partial electric power compensation was made through its return transfer in the aforesaid electric power grid.

Before proceeding to further presentation of the situation, it would be appropriate to specify the reading of a number of notions that will be often used in the text and need the unequivocal interpretation:

- the water year - the length of time from October 1 to September 30 of the next year; the intervegetation period or nongrowing season - October 1 through March 31 of the next year; the growing season - April 1 through September 30;

- all assumptions and proposals outlined in this Explanatory Note concern the average water years while the cases of two extreme situations (the years with abundance of water and years with low water) each time are specified separately. The reasoning that relate to the discharges to the Arnasai depression concern mainly the nongrowing season because the growing season discharges to the Arnasai took place only during the years with abundance of water: 1993-94 and 1998;

- by the Syr Darya water resources are meant the surface water resources collected to the River channel and used by the water consumers of the region.

II. The Change Of The Reservoirs Cascade Operation Mode On The Syr Darya River And Its Impacts. The Proposed Actions For Getting Out Of The Crisis Situation

II.1. The Toktogul Reservoir

It is noteworthy that since 1974 the Toktogul reservoir had no possibility for a long period of time to be filled up, and its storage capacity didn't exceed 5-6 km^3; in this case the forecasting analyses shown that at performing the reservoir's designed operation mode the reservoir may be filled up during 9 average water years or 2 years with abundance of water in succession. This forecast was completely confirmed with the advent of high-water years of 1987 and 1988 when towards August 1988 the maximum storage capacity of 19.5 km^3 was reached, and the reservoir was going into the period of the total reservoir yield. In the same year of 1988 there appeared the first evidences of the change in the Toktogul reservoir operation mode (Fig. 1) connected with the reduction of the coal delivery to Kyrgyzstan and with the simultaneous increase in supply of the Uzbekistan's gas which the *Kyrgyzenergo* JSC compensated by the electric power at the expense of the Toktogul reservoir by increasing the releases from it (up to 3.9 km^3 during the nongrowing season of 1989-1990 water year, in 1990-91 - 4.9 km^3, at the same period of 1991-92 - 5.1 km^3), and the electric power generation at the Toktogul reservoir increased twice - up to 5 million kWh as compared with the preceding period (1985-1987). In the succeeding years the similar changes have been retained but they slightly reflected on the water reserves in the Toktogul since they occurred during the period between two peaks of the high-water years.: 1987-88 and 1993-94.

With the Soviet Union dissolution, the tendencies noted in the preceding period became most conspicuous. At the same time with the advent of 5 independent sovereign states there took place the recession in production leading to the decrease in the heat resources output, and therewith the amount of the mined coal in Kyrgyzstan itself has sharply dropped; and at the same time the intergovernmental and interstate business relations were dissociated. At that time the parts of the water management systems on the Amu Darya and Syr Darya Rivers became the property of the sovereign states which began to use them to satisfy the essential needs on the basis of the necessity to manage with their own potentialities. And the Toktogul reservoir influencing the cascade operation and the Syr Darya River regime during the period of many years was not an exclusion in this situation. In 1992 the delivery of fuel and power resources to Kyrgyzstan from other states reduced drastically, and in view of it, the electric power output at the thermal power plants of the Republic decreased; in addition to that, the lack of the natural gas and coal caused the sharp increase in the electric power consumption in the municipal sector of the Kyrgyz Republic. To meet the raised demands there was performed the transition to the electric power operation mode of the Toktogul integrated hydroscheme that changed the situation in the water delivery to the water consumers in the Syr Darya Basin. Now the maximum output at the HPP felt within the winter period (6 - 8.5 km^3), and in order to accumulate the water in the reservoir the releases from it are reduced during the growing season - up to 4.5-6.5 km^3 (Fig. 1). True enough, during the high-water years of 1993-94 the

situation was mitigated, but it was aggravated when the low-water year of 1995 came. The changes of the last years in the operation mode of the Toktogul reservoir have led to acute shortage of water for irrigation and to the water loss for the Aral Sea since in consequence of inadequate throughput capacity in the lower course of the river the increased in winter water volumes flowing to the Chardara reservoir are being discharged to the Arnasai depression. Therewith the territory of the Republic of Uzbekistan is flooded, and as a result of filling up the Arnasai there is formed the backwater for collectors of the Fergana Valley and Golodnaya Steppe with the subsequent aggravation of the ameliorative conditions of the irrigated areas in the specified regions. Concurrently, the decrease of the summer releases from the reservoir leads to a dangerous ecological and sanitary-epidemiological situation in the basin especially during the low-water years. Even today in the several reaches of the river the flow in summer becomes the minimum one or actually it stops at all while the lack of water in the river in summer at the temperature running to + 75°C in sunlight gives way to infectious diseases and epidemics which don't recognize the boundaries and sovereignties; and the mountains and rivers can protect nobody from this disaster. At last, in case of the electric power operation mode the Toktogul reservoir is bound to emptied losing its ability to regulate the Syr Darya River flow during the period of many years.

It should be noted again that in this respect the Toktogul irrigation operation mode is considerably more effective because it coincides with the natural hydrological regime of the river. Incidentally, the developed during the last years schedule of the reservoir operation has been completely deformed and with it the channel reservoirs operation as well as the river regime have also been distorted. At the average annual natural river flow in the autumn-winter period at the hydroscheme section in the amount of 2,500 mln. m^3, actually it reaches the value of 8.0-9.0 km^3, or more than 3 times exceeds the natural rate. The summer regime has changed in the similar way: the average annual summer flow amounts to 9.0-11.0 km^3 when the releases at the HPP section now come to 4.5-6.5 km^3 or by 1.4-2.4 times less than the natural rate. Thus, the following statement can be made that, in some sense, the winter and summer have changed places: there are floods in winter and artificial low water in summer, therewith these both phenomena are of artificial, man-made nature.

Recognizing the objective nature of the reasons inducing the Kyrgyz Republic to change the operation mode of the Toktogul reservoir, it is worth noting that such tendency in the hydrosystem operation leads finally to develop the crisis situation and threatens to cause not only the economic losses but also the deterioration of the local population health that couldn't be measured with any money.

It should be noted that during the last years the managing of the Naryn-Syrdarya reservoir cascade has greatly become more complicated due to the increased departmental and interstate clash of interests. The government departments under which authority are the Toktogul, Charvak and Kairakkum hydroschemes not always observe the cascade operation mode approved by the ICWC that makes the rational use of the Syr Darya water difficult.

What efforts were made in the search for the way out of the developed situation? During the last years (since 1995) in order to overcome the contradictions

arisen the states-water users took certain measures for reducing their water demands, and they began to conclude the interstate agreements among them where there were set up the values of the compensating deliveries of thermal and energy resources from Uzbekistan and Kazakhstan to the Kyrgyz Republic and there were fixed the rates of the growing seasons' releases from the Toktogul (6,500 mln.m^3) making it possible to provide the needs of the irrigated agriculture in the region during the average annual water year; ensuring the specified releases, Uzbekistan in winter transfers the electric power and delivers gas to Kyrgyzstan, and Kazakhstan supplies the Karaganda coal; in summer the electric power generated at the Toktogul HPP is returned by its transfer to Uzbekistan and Kazakhstan. Therewith, the rates of the winter releases were not specified by the agreements (prior to 1998). Such decision cannot be considered as the optimal one because it was taken, more likely, in case of urgent need in order to get out of the extraordinary situation providing water for the irrigated areas during the growing season, but the problem was not tackled on the whole. In addition, the situation was mitigated by the fact that the years of 1992-1994 were the high-water ones as a result of which there appeared a false impression that it is possible to manage without regulating role of the Toktogul hydroscheme since there is sufficient amount of water. However the abundance of water while mitigating the situation during the growing season at the same time aggravated the pattern of the nongrowing season: when combined with the increased winter releases from the Toktogul reservoir, the elevated natural water content facilitated the rapid filling up of the channel reservoirs (often already in December), and in case of the restricted throughput capacity of the river lower Kzyl-Orda and the developed ice conditions in the lower reaches of the Syr Darya River the water was discharged to the Arnasai depression with the impacts mentioned above.

Thus, since 1991 there were made certain attempts to solve the problem by the compromise actions (to give the water in summer in the reduced amount but to spend it without restrictions in winter) and by the means unfit under new political and economic conditions. However the modern practice indicates that there is compensated that minimum (6.5 km^3) - the water that may be sufficient during the average water year for the vegetative irrigation on the lands in the Syr Darya Basin. Meanwhile, the experience of 1995 demonstrated that with coming of the low-water year the water amount of 6.5 km^3 from the Toktogul is not sufficient for the vegetative irrigation. The winter period was completely given to the disposal of Kyrgyz power engineers which construct their schedule reasoning from the cover of the demands of the Kyrgyz Republic in the electric power, but to attain this it is required to release from the Toktogul reservoir 8-8.5 km^3 of water and even more.

Now let's consider what situation such operation mode leads to during several years with the normal water content. If under the natural conditions in winter the inflow amount to the Toktogul reservoir comes to about 2.5 km^3 and in summer - 9 km^3, the annual inflow doesn't exceed 11-11.5 km^3 but during the last years in winter the water is released from the reservoir in the amount of 8-8.5 km^3 and in summer - 6.5 km^3: that is, total about 15 km^3. It is clear without any complicated estimates that during several years the reservoir is being emptied, and by the early of the winter 1998 there was expected a real threat of the reservoir drawdown up to the dead storage that is inevitable in case of the double load - in summer and in winter. The situation was saved due to the high-water vegetation period of 1998.

Thus, from the technical point of view the Toktogul's operation mode of the last years is wide open to criticism and it may tend to the catastrophe for both the hydraulic power engineering and irrigation. Furthermore, the mechanism of realizing the compensations for the non-generated power is also inappropriate. On the one hand, this mechanism is inadequate since it doesn't allow to reduce the winter releases as it was done prior to 1991 that maintained the Toktogul as the most important regulator of the Syr Darya flow. On the other hand, they were unable to cope with the curtailed task that faced the state authorities responsible for delivery of the thermal power resources inasmuch the political and economic situation in the region had radically altered as a result of which there occurred the following:

- each state of the region, which has become independent, in its own way understands the problems facing these facilities of the cascade that became the property of a certain state whereas these facilities should operate in co-ordination to one another as it was stipulated by the project;

- the downswing in production and general rise in prices for everything including the thermal resources and electric power were responsible for the long-run coordination by the parties of the prices in the course of concluding the agreements between them as happened in 1995 when the Agreement between Kazakhstan and Kyrgyzstan was signed in the second half of June, and the increase of the releases from the Toktogul couldn't already achieve their goal;

- the methods applied in the Soviet Union for performing compensations were reasonable and corresponded to the nature of economic relations and to that mechanism which existed in the country with the planned system of economic management and strict system of distribution; it will be recalled that the former country had great potentialities and among them - not in the last place - the ability to monitor implementation of the decisions adopted; but the same cannot be said of the methods applied after 1991 because in case of radically changed situation there were used the old means, and under developed conditions they proved to be impractical; conclusion of the agreements and their implementation were charged to the state structures which more commonly selected one single way of the all means available without adequate feasibility study.

The desire for solving all the challenges through the governmental structures in case of the changed situation not infrequently brings the unfavorable result. This is the reason that the intergovernmental agreements stipulating the compensation deliveries of the thermal power resources were not performed and are not being fulfilled in the full volume: for example, the Republic of Kazakhstan in 1995-1996 water year delivered only 200 thous. tons of the Karaganda coal of the total amount 600 thous. tons specified by the Agreement; the succeeding arrangements were also not fulfilled.

The impacts of such breakdowns are evident, and from the Toktogul reservoir the water is released in more volumes than it was stipulated by the Agreements. The lack of the executive discipline and unreliability are particularly intolerable when using the water resources since the planned actions should be deferred for afterwards:

the water has gone and the exact moment was missed, and the lost resource cannot be recovered.

One more specific complexity in the water resources management lies in the fact that the states may make arrangements between themselves not taking into consideration in the documents the availability of some barriers in the path of the water flowing on the side of the third states (or third parties, or departments) which interfere with the situation and disrupt implementation of the agreements; as an example let's consider the aforesaid growing season of 1995 when the water released from the Toktogul reservoir by the agreement between Kazakhstan and Kyrgyzstan was not permitted to passage through and was detained in the Kairakkum reservoir by the Tajik Power Company *Barki Tochik*. The agreement between Uzbekistan and Tajikistan was for the first time concluded only in 1998. The execution and implementation of this Agreement are also far from being perfect.

Thus, the paradoxical situation arises so characteristic for the transition period: the starting conditions has changed but the operating procedures remained as they were previously not suitable for the present situation. That is the reason why such sufficiently effective mechanism as the compensation deliveries not always and with great difficulties can remedy the situation. There occurred the situation that best of all may be characterized by the words of A. Lincoln: «The dogmas of the peaceful past are unsuitable for the vigorous days of the present. The situation is extremely challenging but we must ascend to the level of the present moment requirements. Since we are confronted with a new situation, we should both think in a new way and act in a new way...»

As for the Toktogul reservoir being the largest one on the Syr Darya River, the water year should be regarded as the integral whole, and its operation mode should not be broken for the components by the periods of the year as it was in 1995-1997 when the momentary problems were primarily being solved: to ensure the vegetative releases without adjustment of the winter operation mode that finally caused the reservoir drawdown that may jeopardize both the irrigation and hydropower sector. It is required to substantiate primarily the volumes and operation mode of the releases from the Toktogul during the nongrowing season and to compensate to the *Kyrgyzenergo* the detained during this period water in the reservoir basin. Only in this case it will be able to restore and maintain the role of the Toktogul hydraulic system for the Syr Darya River. Under certain conditions the water saved in winter in the Toktogul reservoir will be sufficient to cover the irrigation needs during the growing season, and only in the last resort, it will be necessary to search for optional resources in the summer period. Setting up control over the winter releases' rates from the Toktogul reservoir, it will be possible to avoid at a time the releases from the Chardara reservoir to the territory of Uzbekistan. So the BVO Syr Darya recommended for the water year of 1997-1998 the volumes of the autumn-winter releases from the Toktogul reservoir justified through estimates in order to initiate the gradual accumulation of water in the reservoir eliminating at the same time the water discharge from the Chardara reservoir to the Arnasai depression. The estimates demonstrated that in such case the nongrowing season releases from the Toktogul reservoir should not exceed 5.5 km^3, and some forecasts for the operation mode of the Naryn-Syrdarya Cascade were drawn up during the nongrowing and growing

seasons where there were also specified the volumes of water detained in the Toktogul reservoir which were needed to be compensated to the *Kyrgyzenergo* JSC through the deliveries of the power resources for solving the aforesaid tasks. These BVO's recommendations were taken into consideration in the respective intergovernmental agreements in which it is stipulated to ascertain the volumes of releases from the Toktogul reservoir during the nongrowing season in the amount of 6 km^3 and during the growing season - 6.5 km^3, therewith the Kyrgyz Republic declared about reducing its own power consumption by 10% as compared with the achieved one in 1997. Unfortunately, the agreements were concluded with some delay, they were fulfilled not always at the stipulated period and not always in the complete volume. As a consequence of it, the water was released from the Toktogul reservoir by 1 km^3 more than the specified volume; furthermore, 2.2 km^3 of water were discharged to the Arnasai depression during nongrowing season through the variations in the Kairakkum reservoir operation as compared with the planned schedule, the increased releases from the Toktogul reservoir and enlarged actual lateral inflow in the region Kairakkum-Chardara. To the beginning of the growing period 7.2 km^3 of water were left in the Toktogul reservoir that only by 1.5 km^3 exceeded the dead storage value.

Meanwhile, the drawdown of the Toktogul reservoir up to the dead storage brings to the situation taking place after putting the project into operation when the reservoir has been filling up. However at that time there was a technical necessity, and feasibility of the actions was substantiated by economic calculations. Sometimes it is required to decrease the reservoir's dead storage for compensating the water deficit during very low-water years. In this situation there should be performed the economic comparison of the losses in the power sector because of reducing the water head, drop in efficiency of the HPP's turbines (on account of operation in the non-estimated water head zone) and in a number of cases because of the total standstill of the units for the time being under some technical conditions with the effect (for the most part it is the one-time effect) in agriculture. Therewith the losses in the power sector from the moment of the dead storage drawdown may be prolonged for a considerably greater period (up to several years as far as the attainment of the normal maximum operating level).

Such a situation occurred at the first stage of the Toktogul hydroscheme functioning under conditions of the designed operation mode. But now the situation may arise (and at the beginning of 1998 we, as never before, were close to such situation) when the reservoir through the hydraulic system operation during all last years in the electric power regime will come up against the necessity to draw down its dead storage to generate the electric power during the nongrowing season, and the loss in such situation will be no longer covered by the income from the irrigated agriculture. It seems to us that with the up-to-date approaches to the developing situation in the Basin, one should not ignore a potentiality of occurring such conditions.

However, the water management situation during the growing period of 1998 has significantly improved due to the actual water availability; for example, by the early vegetation period the total volume of water in the major reservoirs of the Naryn-Syrdarya Cascade was by 3.6 km^3 less than previous year, so by October 1 this

indicator became by 6.2 km^3 more than on the same date of 1997. And it took place despite the fact that during the growing season there were released by 7.73 km^3 of water more then it was stipulated by the schedule of the cascade operation mode. Since the needs of the water consumers were primarily satisfied on account of increase of the lateral inflow to the channels of the Syr Darya, Chirchik and Karadarya Rivers, from the Toktogul reservoir there were released only 57% of the water volume stipulated by the intergovernmental agreements. As a result of this, in the Toktogul reservoir itself there were accumulated over 15 km^3 of water, and rather good prospects have appeared for restoring the role of this reservoir as the long-term regulator of the Syr Darya River flow - and this is the major favorable result of the bygone growing season of 1998. The considerable amounts of water are reserved in the Charvak and Andizhan reservoirs. It is significant to note, that even during the hottest months of the period under consideration it was able to ensure the sanitary releases regime in the middle and lower courses of the Syr Darya River facilitating the preservation of favorable ecological and epidemiological situation in the Basin. Therewith, the volume of the releases to the Aral Sea have increased and amounted to 3.54 km^3 as compared with the volume of 1 km^3 approved by the ICWC for the growing season. It should be emphasized that in the last 10-years period for the first time during the growing season the Aral Sea received more water than during the previous nongrowing season. But the abundance of water made it impossible to draw down the channel reservoirs by the end of the vegetation period. Moreover, for some time in June 1998 with the filled up channel reservoirs, increased inflow to the Charvak and Andizhan reservoirs and the raised lateral inflow in the middle course of the Syr Darya River, over 1,800 m^3/s entered the Chardara reservoir, and as the consequence of this it was necessary to discharge about 850 m^3/s to the Arnasai depression and during the total growing season -1 km^3 of water; before this the water discharge to the Arnasai depression took place only during the high-water years of 1993 and 1994. The high water availability was accompanied by considerable precipitation; for example, already in June their amount exceeded the precipitation rate by 2-4 times. This reflected on the amounts of the water diversions the volumes of which appeared to be lower of the diversion limits in every state - water consumer.

Unfortunately, in the coming water year (1998-1999) the same event is again taking place: the growing season has begun but the agreements drawn up already in September 1998 have not been signed till now by all states of the Syr Darya Basin. As a consequence, there are released 8 km^3 of water from the Toktogul reservoir instead of the stipulated amount of 6.8 km^3 for the nongrowing season, by the beginning of the vegetation period 10.5 km^3 of water remained in the reservoir, and 3.1 km^3 were discharged to the Arnasai depression.

II.2. The Charvak And Andizhan Reservoirs

No doubt that transition of the Toktogul hydraulic system to the electric power regime (increase of the nonvegetative releases by 2.5-3 times) is the major reason of the nonrational use of the Syr Darya water resources. After all, the observance of its operation mode made it possible to do without the water losses even during the high-water years but after 1992 the discharges to the Arnasai depression took place every year regardless of the water availability level accepting the regular nature. This situation could be mitigated by the Charvak reservoir but it also operates, first and foremost, to satisfy the power sector requirements. It has been known that as a consequence of the great turbidity of the water in the Chatkal River during the flood (the filling up of the reservoir) the sediments are deposited in the region of *Burchmulla* and *Yakkatut* settlements. In case of lowering the water elevation below 875.00 during the period from November to March, the fine fractions of the deposited sediments being raised by wind facilitate formation of the dust storms. As an alternative, The Ministry of Power of the Republic of Uzbekistan proposed to maintain the dusting plots of the reservoir's bottom flooded during the winds period, or nongrowing season. The Institute *Tashgidroproekt* carried out work on substantiating the operation mode of the Charvak reservoir under the recommended conditions taking into consideration the demands of irrigation and of other water consumers as well. It was depicted that this proposal couldn't be realized during the low-water years since the frequent and deep irregularities are inevitable, that is, in case of restricting the drawdown of the Charvak reservoir, the harm may be caused, first of all, to the industry and municipal economy and to the ecological situation of the area under the reservoir's control the limitation in water supply to which is impermissible. Therewith, practically no losses will be incurred to the power sector.

But let's consider how the inflow of the Chirchik River influences the Syr Darya River during the intervegetation period of the high-water years when the winter releases from the Charvak reservoir reach great volumes and the inflow of the Chirchik's water to the Syr Darya River in autumn and winter is so considerable that being added to the artificial flood created by the Toktogul's winter power releases it aggravates the existing tense crisis situation that is solved by discharging the waters to the Arnasai depression.

The estimates of the operation mode of the reservoir and the reach between the Charvak River and the mouth of the Chirchik River during the nongrowing season for the last several years were performed by the BVO Syr Darya in experimental order with the introduction of only one restriction: the lower limit of the Charvak reservoir drawdown was taken equal to 875.00. From the gained results it follows that in high-water years of 1993 and 1994 under observance in the operation mode of the Charvak reservoir of the nonadmissioning of the dust storms occurrence, at the same time one more result could be attained: to gain during the intervegetation period of the aforesaid water years the reduction in the water discharges' amounts to the Arnasai depression almost by 20%. Thus, during the high-water years two results can be obtained without any supplementary costs only by way of changing the operation mode of the Charvak reservoir:

1. The dust storms shouldn't be admitted to occur.

2. The nonproductive losses of water should be reduced by decreasing the discharges to the Arnasai depression.

Let's try to assess the role and influence of the Andizhan reservoir operation and the Karadarya River on the functioning of the whole Naryn-Syrdarya Cascade. The analysis demonstrates that at the elevation of the water availability in the Karadarya River and increase of the releases from the Andizhan reservoir associated with the raised inflow to it the excess discharge enters the Syr Darya River.

Thus, during the abnormally high-water year of 1993-1994 through the *Uchtepe* hydraulic post there were passed 2,600 mln. m^3 instead of 1,500-1,600 mln. m^3 as compared with the average water year, that is, the excess water volume of about 1 - 1.1 km^3 has aggravated the water management situation in the region of the Chardara reservoir constituting about 15% of the total discharge to the Arnasai depression.

It is necessary to analyze singly the increase of the water availability during the growing season associated with the excess runoff discharges from the Andizhan reservoir to the Karadarya River. A part of this excess flow is diverted by the canals of the Andizhan Oblast, by the Great Fergana Canal (GFC) on the Karadarya River, and the rest of the flow is discharged downstream through the Kuiganyar Dam. The characteristic cases were the growing seasons of 1993, 1994 and 1998 when through the Uchtepe hydraulic post there had passed 3,690; 2,811 and 4,149 mln. m^3 of water respectively; if it is considered that the normal vegetative rate through the Uchtepe post amounts to about 1,450-1,500 mln. m^3, so this means that the situation in the area of the Chardara reservoir has even more aggravated. To this must be added that during these above-mentioned vegetation periods the water was discharged to the Arnasai in the amount of 1-1.2 km^3.

Thus, the intergovernmental contradictions tend to the fact that the role of the Charvak and Andizhan reservoirs in the nonrational use of the Syr Darya Basin water resources increases during the high-water years with the increase of the inflow to the Chardara River and discharge to the Arnasai. For example, during the high-water year of 1993-1994 the supplementary discharges during the autumn-winter period from the Andizhan and Charvak reservoirs increased the releases to the Arnasai depression approximately by 34% of the total volume of such water losses.

II.3. The Channel Reservoirs Of The Cascade - The Kairakkum And Chardara Reservoirs

Now let's refer to operation of the channel reservoirs of the Naryn-Syrdarya cascade the functioning of which under the described modern conditions and with the efforts to maintain the tendencies put in the project also could not ensure the optimal use of the Syr Darya Basin water resources. It is known that in accordance with the project there was stipulated for this period of time the accumulation of water in both reservoirs by the early growing season, so no wonder that so far as the designed operation mode was observed, the inflows always exceeded the releases (Figures 2 and 3). Besides, the change in the operation mode of the Toktogul reservoir has an immediate impact on the functioning of the Kairakkum and Chardara reservoirs that is readily illustrated by Figures 2 and 3 where there are shown the inflow and releases during the intervegetation period beginning from 1974 up to the present. It should be recalled that the growth of the Toktogul releases' volumes was noted since 1987-88 and, first of all, during the nongrowing season when, as it is known, the volumes of lateral inflows in diverse years vary not very considerably deviating from the normal values within the limits of 15-20%, with the result that the impact of the Toktogul reservoir regime on the cascade operation becomes the determining one, as a whole. That is the reason why exactly in 1987-88 water economic year there increased the inflows (and inevitably - the releases) of the both channel reservoirs. But since the Toktogul's releases during this period (before 1992) didn't exceed 5 km^3, the nonproductive losses of the Syr Darya water were not observed.

This point was got past in 1992-1993 water year when through the Toktogul hydraulic system there were released about 6,100 mln. m^3 during the nongrowing season, and as a consequence of it the releases to the Arnasai depression began to take place; in the subsequent years this indicator increased still further coming up to km^3. But the sense of purpose by its nature of the previous operation mode of the channel reservoirs was preserved, and with reference to Fig. 2, it can be seen that the inflows continue to exceed the releases (with one exception - March of 1997 when for ensuring the necessity to carry out repair works, from the Kairakkum reservoir there were drawn down 470 mln. m^3 in addition). In 1988 the inflow to the Kairakkum reservoir instead of 4-5 km^3 during the preceding period increased up to 8-9 km^3 (the releases raised from 3.5-6 km^3 to 6-8 km^3 respectively), since 1992 the inflows reached the value 10-12 km^3 and the releases: 10-12 km^3.

The character of the Chardara reservoir operation was similar although as a consequence of certain restrictions downstream the Syr Darya River (the ice conditions and the regulating facilities for water diversion to the *Aitek* canal), the releases towards the lower reaches couldn't increase proportionally to the increase of the inflow (Fig. 3), and the difference in the water amounts was discharged to the Arnasai depression; the inflows to the Chardara reservoir increased from 3-6 km^3 to 7-9 km^3 (in 1987-1991) and up to 10-15 km^3 (from 1991 to 1999); while the releases raised from 1-3 km^3 (1974-1987) to 4-6 km^3 (1987-1992) and then up to 5-8 km^3 (during the last years).

But the fact was that at the time when the winter releases from the Toktogul reservoir increased by 2-3 times, the channel reservoirs has no need for the water

accumulation since the beginning of the intervegetation period because at the inflow growth the Kairakkum reservoir was filled up even in December, whereupon the releases were over 1,000 m^3/s; even greater flow rate went to the Chardara, and the discharge to the Arnasai depression had become inevitable.

The changing of the channel reservoirs' operation mode during the nongrowing season with consideration for the altered initial conditions, of course, is not a panacea from all troubles but it can mitigate the situation and during the normal water year it can help if not to liquidate the discharge to the Arnasai (this is true only at observing the intergovernmental agreements as to the compensation deliveries) but to render assistance in decreasing the discharge amounts.

The objective of adjustment of the channel reservoirs cascade's operation mode involves its optimization in order to avoid the discharges to the Arnasai depression or all possible reduction of such discharges. The fundamental difference between the proposed approach in distinction to the method previously applied resides in the fact that the necessity was considered for changing the rate of filling up the channel reservoirs during the nongrowing season. When before 1992 from the Toktogul reservoir there were released 3-4 km^3 of water in the autumn-winter period, the rate of filling up the channel reservoirs was relatively steady during the whole intervegetation period. With the increase of the amounts of the Toktogul releases and inflows to the channel reservoirs, the latter became to be filled up far earlier. But in case the Kairakkum reservoir changed its operation mode to the household water regime therewith increasing the releases up to 900, 1000 m^3/s and more, the Chardara operation mode developed in some other way. The releases amounts from the Chardara reservoir are restricted by the ice conditions in the lower reaches of the Syr Darya River and by the throughput capacity of a series of hydrosystems lower Kzyl-Orda town, and as a consequence of it, after filling up the reservoir's storage (and in case of the great rate in the filling up - before this moment) the excess water was coming to be discharged to the Arnasai depression.

It has been known that the active volume of the Kairakkum reservoir has decreased since the time when in accordance with conditions for ensuring the operation of the Makhram pumping station its drawdown was limited by the elevation 343.50 (no less than 1,716 mln. m^3 at the dead storage of 890 mln. m^3) hence making up half of the total storage of the Kairakkum reservoir (3,418 mln. m^3); now till the end of the growing season it's necessary to reserve the volume of 1.0 km^3 above the dead storage, but this water is retained in the reservoir and after October 1 - obviously, in the interests of the hydropower sector. Meanwhile, this operation makes no sense - and moreover, there is no need for this because under the Toktogul's power operation of the last years the Kairakkum reservoir is filled up already in December-January, and since that moment it changes to the household regime discharging downwards all the volume of the coming inflow. So the aforesaid 1,0 km^3 of water reserved during the growing season and, unfortunately, after completion of that period becomes the supplementary load, and upon the filling up of the reservoir is being discharged downwards increasing the inflow to the Chardara, and finally it enters the Arnasai depression. These are supplementary difficulties relating to the Kairakkum reservoir. Should the water reserved during the growing season for the Makhram pumping station be released at the beginning of the intervegetation period, the emptied

by this way storage with the capacity of one cubic kilometer could serve as the reserve storage in January-March. By the way, during the normal water years the non-vegetative discharge to the Arnasai depression usually amounts to about 1 km^3. So, as applied to the Kairakkum reservoir the task during the nongrowing season, in the first place, comes to the drawdown during the initial period, if only partially, of that water volume which was contained within the growing season for the Makhram pumping station and so to formation of the reserve storage, and, secondly, to such changing of the reservoir operation mode that its filling up was not performed spasmodically, drastically growing in February and March and increasing the discharges from the reservoir up to 1,000 m^3/s and over, as it took place after 1992; the increase of the releases during the first half of the nongrowing season will decrease their amount in the second half of the period. Among other things, such alignment and reduction of the releases volume during the second half of the nongrowing season is beneficial in terms of contraction to the minimum of the volumes of the no-load discharges through the hydrosystem since the maximum rate through the turbines is as great as 850-900 m^3/s.

A different type of situation occurs at the Chardara reservoir being drawn down by the end of the growing season up to the dead storage. In order to attain the optimum, it is necessary in good time to develop below Kzyl-Orda town the so called «ice pipe» of the maximum large dimension, for which purpose there should be maintained the constant volume of the releases from the Chardara in December-February, the limiting value of which shouldn't exceed 400 m^3/s.

Thus, the change of the operation mode for the Naryn-Syrdarya Reservoirs Cascade will make it possible to use more rationally the Syr Darya water, for which purpose it is necessary to perform or observe the following.

The elimination of the discharges to the Arnasai depression or their minimization can be effected only in case when the inflow to the Chardara reservoir doesn't exceed

11 km^3, and that is possible when the value of the nongrowing season releases from the Toktogul reservoir is not more than 5.5-6 km^3.

As regards the releases to the Aral Sea and the Aral Sea coastal region, the maximum can be attained in case of increasing in October-November the volume of the releases from the Kairakkum reservoir no less than 800 m^3/s drawing the reservoir down up to the dead storage (890 mln. m^3) and in doing so to form the reserve allowing to mitigate the peak of releases in January-March at the maximum inflow to the reservoir within the specified period.

During the same period (October - the first half of November) from the Chardara reservoir there should be discharged at least 550-600 m^3/s gradually reducing the releases' volume during the second half of November up to 400 m^3/s and maintaining it constant within about 4 months - as far as the middle of March. Only after this it is possible to begin to increase the releases from the Chardara - down to 700 m^3/s (depending on the ambient air temperature and the ice conditions in the lower reaches of the Syr Darya River). Such operation mode will allow to discharge during the nongrowing season from the Chardara reservoir, depending upon the winter

climatic conditions, from 7 to 8 km^3 of water and to deliver from 4 to 5 km^3 to the Aral Sea and the Aral Sea coastal region.

The first attempt in realizing similar regime of the channel reservoirs took place during the last nongrowing season: 1998-1999 water year. The ICWC, upon consideration of the proposal of the BVO Syrdarya concerning the change of the channel reservoirs operation at the meeting in the city of Cholpon-Ata in August 1998, recommended to put it forward for discussion and coordination at the working meeting of the representatives of the fuel-and-power and water management industries of the Central Asian states in the Syr Darya Basin planned to be held in Bishkek City (23-26 August of this year) where there will be coordinated the general provisions of the intergovernmental agreements on the Basin's water and power resources use. In addition, the BVO's proposal was forwarded to the Republic of Tajikistan (Ministry of Water Management and *Barki Tochik* Company) and to Kazakhstan (Committee on the Water Resources of the Ministry of Agriculture).

The Ministry of Water Management of the Republic of Tajikistan and the State Joint-Stock Holding Company *Barki Tochik* in response to this presented the agreed by the both departments version of the Kairakkum reservoir operation the releases from which in October amount to 300 m^3/s, then they increase every month reaching 860 m^3/s in March which meant the maintenance of the former approach tended to the water accumulation from the very beginning of the growing season. True enough, only before October 12,1998 from the Kairakkum reservoir there were released 200 m^3/s, and then, contrary to its own schedule, the releases increased up to 800 m^3/s indicating the growing similarity of the actual operation mode to the proposed version of operation which during the rest nongrowing season was observed rather closely - taking into consideration the occurring deviations in the operation mode of the Toktogul reservoir (8 km^3 against 6.5 km^3). As regards the Chardara reservoir, the Kazakhstan party very thoroughly withstood the approved regime making some adjustments of it only in case of the changes in the reservoirs of the Cascade situated upstream.

Thus, with certain variations, the proposal on the change of the channel reservoirs operation mode for the first time was realized during the last nongrowing season. It should be immediately specified that this season, as would be expected, has occurred to be the high-water period, and the water discharge to the Arnasai depression was considered in all forecasting studies - under conditions of observing the proposed regime of the Cascade operation, making deliveries in the fill volume of the heat- and power resources and carrying out the obligations of the parties accepted at the ICWC meeting in Khojent City (October 1998), the volumes of the discharges to the Arnasai depression could amount to 1.75 km^3. Through the deviations from all the listed parameters, the actual volumes of discharges increased up to 3.1 km^3 during the nongrowing season. It is required, if only for the first approximation, to estimate the efficiency of the proposed change of the channel reservoirs operation mode, for which purpose the finished period should be compared with the similar period - the nongrowing season of 1994-1995 water year basing on the following major moments:

- in the both cases the water availability was practically the same: 118% in 1994-1995 and 120% in 1998-1999;

- the releases from the Toktogul reservoir are practically equal: 8.2 km^3 (1994-95) and 8 km^3 (1998-99).

There is also the distinction - by the beginning of the last nongrowing season in the channel reservoirs there remained not drawn down about 1 km^3 of water, that is the starting situation in 1998-1999 appeared to be more rigid than in 1994-1995. However, due to the changed operation mode of the Cascade, there were discharged to the Arnasai depression during the autumn-winter period by 0.8 km^3 of water less than in 1995. That is the reason why it is possible to speak about a certain effect of the proposed change in the channel reservoirs operation mode. The following practice of the Cascade operation may confirm it in case it's possible to realize the contemplated regime completely.

III. The Syr Darya Basin Water Resources Use In 1995-1998

In the most general form, the amount of the water resources available and their distribution within the considered by us period is shown in Table 1. The detailed sharing of the Syr Darya water by the countries-water consumers of the basin is presented in the documents of the Working Group members from the national organizations engaged in assessment of the situation in the area of the water and power recourses use (Refer to Annexes). Here we concern the problems of the water losses; the discharges to the Arnasai depression were already discussed earlier, but it may be of interest to correlate the amounts of the discharges to the Arnasai depression with the releases to the Aral Sea and the Aral Sea coastal region - see Figures 4 and 5; the period under study - since 1992 when, strictly speaking, there appeared discharges to the Arnasai depression. The analyzed value are shown as a whole in Fig. 4 by every water economic year while Fig. 5 depicts the same but separately by the periods: the nongrowing season and the growing season. Unfortunately, these data compare well by the volumes, and from Fig. 5 follows that sometimes (during the high-water years) the discharges to the Arnasai are even more than the releases to the Aral Sea and the Aral Sea coastal region as happened during the intervegetation period of 1993-1994 water economic year.

As mentioned above, the discharges to the Arnasai depression resulted when Toktogul reservoir changed over to the power regime, while the increase in the water supply to the Aral Sea in many respects depends upon the readiness of the Syr Darya channel between the Chardara and Aral for the releases of greater volumes. Therewith, this occurs not only in winter when the ice formation below Kzyl-Orda town restricts the releases from the Chardara reservoir in the range from 350 to 400 m^3/s (the greater amounts are rare in occurrence - the dimensions of the ice «pipe» are determined by the water flow traveling along the river at the moment of the channel freezing and the date of the ice formation).

But the restrictions are found in summer as well, and the main barrier on the water way to the Aral Sea is the Aitek canal, the water intake facility, the throughput capacity of which is 400 m^3/s, but actually it amounts to 350-360 m^3/s. Therefore, any increase of the releases from the Chardara hydrosystem (up to 1,500 - 1,600 m^3/s) doesn't at all mean that the specified water less the water supply and ecological releases will flow into the Sea since the Aitek hydrosystem cannot allow passage of the water flow greater than it was mentioned above. As an example we refer to the growing season of 1998 when at the beginning of May the Chardara hydrosystem released downstream no less than 1,000 m^3/s, and with allowance made for the channel travel this water reached the Aral Sea at the beginning of June. But in June at the Karateren hydraulic post the flow rate of 200 m^3/s was recorded day after day. The increase of releases from the Chardara reservoir in June caused the necessity to restart discharges to the Arnasai depression. Thus, by increasing the releases from the Chardara reservoir to the maximum, we will not be able to obtain the adequate volume of the water delivery to the Aral Sea.

SYR DARYA RIVER WATER RESOURCES USE
(the river channel, 1995-1998 water years)

Table 1

km^3

Water Year	Water resources available			Water resources use and sharing						
	Water resources	Drawdown of the channel reservoirs	Total	Water diversions	Water Accumulation in the channel Reservoirs	Technological losses - the channel and reservoirs losses	Water supply to the Aral Sea and to Aral Sea coastal region	Flooding of Syr Darya floodplain - downstream the Chardara reservoir	Discharge to the Arnasai depression	Total
1994-1995	33.46	0.9	34.36	19.15	-	3.34	6.43	1.49	3.9	34.31
1995-1996	34.05	-	34.05	22.2	1.2	4.14	3.86	2.37	1	34.77
1996-1997	33.73	0.23	33.96	20.67	-	3.78	5.1	2.72	1.23	33.5
1997-1998	40.59	-	40.59	21.53	1.36	4.38	5.87	4.5	3.2	40.84

It's obvious that the problem comes to the appropriate preparation of the channel from the Chardara to the Aral Sea, and if we don't turn to this problem in the coming years, a good result won't be obtained. For fairness sake it should be noted that at the end of the recently completed nongrowing season the obstacle in the area of Aitek was eliminated, and now it remains to wait what result will be produced. Unfortunately, in winter this problem of the throughput capacity of the Syr Darya channel remains to be solved.

One more type of the losses is noteworthy which reach great volumes during the high-water years. While the channel and reservoir losses may be assigned to the so called technological losses, the discharges to the Arnasai are considered to be consumptive water use. The similar by their origin losses arise during high-water intervegetation periods - the case in point is the flooding of the floodplain of the Syr Darya River downstream the Chardara reservoir, especially between Kzyl-Orda and the Aral Sea coastal region. Without going into details as to the nature and reasons of this phenomenon, it should be noted that the water resources sharing downstream the Chardara reservoir not always may be precisely recorded, and what's more it is not kept there, so one is forced to speak herein about certain matters of convention accepting which the specified losses may be assessed. The releases from the Chardara reservoir are distributed as follows:

- water delivery to the Aral Sea and the Aral Sea coastal region;
- water diversion in the Chardara - Aral reach;
- ecological releases towards the lower reaches;
- consumptive water use or flooding of the river floodplain and adjacent areas.

The first two items are estimated adequately since they are accountable. The second item may be accepted by the designed developments where there is specified the value of the ecological releases at 2 km^3 per one water year. Taking into consideration the change of the Toktogul hydrosystem operation mode during the autumn-winter period, without particular inaccuracy it may be tolerated that the volumes of releases to the lower reaches now are divided by the periods (the growing and nongrowing seasons) evenly, that is, by 1 km^3. In this case non-rational losses (the flooding of the floodplain) are the difference between the releases from the Chardara reservoir and the listed above three constituents. It should be mentioned that this difference most often occurs during the high-water years, principally during nongrowing season, when the ice conditions restricts the throughout capacity of the river channel, but the summer restrictions (the Aitek facilities - till March 1999) were also the reason of the losses under consideration, for example, about 2.5 km^3 during the growing season of 1998.

Since the technological losses are inherent in the functioning of the water management complex and the discharges to the Arnasai depression or the flooding of the floodplain are the result of the non-rational water use by the man and they may be eliminated when taking appropriate actions, it is worthwhile to estimate their aggregate value by correlating the losses with the water delivery to the Aral Sea and

the Aral Sea coastal region (in a similar way as shown in Figures 4 and 5), that is, to combine the volumes of discharges to the Arnasai with the volumes of the water flooding the Syr Darya floodplain downstream the Chardara reservoir (Fig. 6). As may be seen from the Figure, these volumes are rather common not only correlated with the releases to the Aral Sea but, in case of the high-water growing season, exceed them reaching 10-19% of the volume of the water resources available (over the period under study). The decrease in the similar type of the losses associated with the increase of the throughput capacity on the Syr Darya River channel in the lower course is the urgent matter of the nearest future that will make it possible not only to increase the water delivery to the Aral Sea and the Aral Sea coastal region but also to raise the water availability in the region and to eliminate adverse impacts caused by the uncontrolled losses of water doing damages to the economic infrastructures of this Basin's states and to the Basin's soils impairing the sustainability of the biosystems in Central Asia.

In this connection of some interest is the analysis of the current state of the lakes system of the Arnasai depression carried out by the *Uzglavgidromet* Department in accordance with instruction of the Cabinet of Ministers of the Republic of Uzbekistan and employed in the materials of the Annexes to this Explanatory Note (the information of the Ministry of Agriculture and Water Management of the Republic of Uzbekistan). On the basis of stimulation it may be concluded that the annual discharges from the Chardara reservoir at the volume less than 1.5 km^3 will tend to the slow contraction of the lakes' system, and what's more, under conditions of the releases stoppage from the reservoir, during the first three years the water level in the lakes will decrease by 0.4-0.6 m per year. In due course, the intensity of the elevation drop will decrease, and in prospect it will stabilize at the elevation about 238 m. But in case of continuing the releases in volume over 1.5 km^3 , there will take place the flooding of new pasture areas , therewith each subsequent cubic kilometer of water will increase the water elevation by 0.2-0.3 m and will flood 50-70 km^2 of the territories. The main conclusion of the study implies that the adverse effects of the flooding involve not only the taking of a part of the territory out of its economic development but also the moment that in case of subsequent reduction in the water level «the dried bottom of the lake can be hardly recultivated, and... the territories flooded for a long period of time wouldn't be used effectively in the economic activities».

The present Explanatory Note is concerned with the analysis on using the water diverted from the Syr Darya River channel and distributed between the states-water consumers of the Basin and the Aral Sea. The level of the Syr Darya water use by the water consumers should be shown by every state separately with the assistance of the Working Group members approved at the meeting in Almaty on March 10-11 of this year. Unfortunately, as for now, (the second part of April of the current year) the materials on assessment of the situation in the water resources use have been presented only by the Working Group from the Republic of Uzbekistan and Tajikistan (Refer to the Annex). The study of the specified materials will allow to draw the following conclusions:

- There are relatively great reserves for increasing the level of applying the diverted water. This is apparent, first and foremost, from the irrigated agriculture indicators

considering that the most part of the water is used in agriculture (the Republic of Uzbekistan - from 81% to 86%; the Republic of Tajikistan - from 83% to 89%); among other factors, the efficiency of the irrigation systems (Republic of Kazakhstan – from 0.61 to 0.57, Uzbekistan - 0.64 and Tajikistan - from 0.68 to 0.72) can not be considered as the satisfactory one, and it indicates the low technological level of the irrigation system and considerable losses of the irrigation water used in the irrigation farming;

- The same is true for the water consumption rate in the Republic of Tajikistan being equal to 0.7 (in the Republic of Kazakhstan – 0.95, in the Republic of Uzbekistan - 0.97) that means the loss of one third of the water diverted from the Syr Darya. The more thorough analysis of the presented data is may be hardly performed, but it should be recalled that the prime cost of one cubic meter of water in the Republic of Tajikistan where prevail the lands with the mechanical irrigation is considerably higher than in the Republic of Uzbekistan, so it is difficult to understand for what reasons the water in Tajikistan is used worse than in Uzbekistan. This matter should be elucidated later on;

- Unfortunately, as to the Republic of Uzbekistan, the data on the ameliorative state of the irrigated lands and on the technical conditions of the facilities are presented only by one year while it would be very important to see these indicators in dynamics within the period under consideration; from the data of the Republic of Tajikistan (Annex, Table 4) one can clearly see the aggravation of the technological state of the irrigation and drainage systems, and as a consequence of this there observed the growth of the areas having unsatisfactory ameliorative state of the lands, and such situation is quite ordinary by reason of reduction or lack of financing for the respective operations;

- As an indirect evidence that similar processes occurred in the Republic of Uzbekistan (the growth of the non-properly improved lands, deterioration of the technical state of irrigation and collector-and-drainage networks and their facilities) there will be the final result of activities in the irrigation agriculture - the value of the crop yield; in the both states this indicator drops that also indicates about nonrational use of the water resources.

IV. Conclusion And Findings

It was not the object of this Explanatory Note to propose certain optimal decisions and to be concerned in general with the search for the optimum, however inevitably the overall analysis of the existing strategy in the water sharing and use in the Syr Darya Basin and in the Central Asian region as a whole brings to the necessity to state the idea regarding the feasible actions as to the problems of improving the situation being developed in the course of all last years.

From the material presented it is obvious that in the process of functioning of the water management sector in the Syr Darya Basin there are observed the features common with the world practice in the water resources use including the contradictions between the upper reaches region having great potential reserves of the hydropower resources and small amounts of the irrigated lands and the lower reaches region having exactly the opposite interests and potentialities. The world practice has accumulated rather great experience in solving similar contradictions and for fairness sake it should be noted that in one form or another such experience was applied in the former Soviet Union, and at that time many valuable approaches were developed in this country independently. There were shortcomings as well being peculiar to the state regime on the whole, the major of which was the lack of the economic approach so characteristic for the world market system. However, there were also certain advantages: the unified management, although is was of the administration and command style, and immense potentialities of the powerful state and the developed economic relations which, unfortunately, were too fast broken down after 1991, while the interdepartmental conflicts that existed for all time were considerably sharpened with the advent of the independent states in the Central Asia, and these contradictions have gradually developed into the interstate ones.

The historical experience suggests that subsequently quite often we are forced to revert to the past experience discarding the errors inherent in it but taking all rational basing on the common sense. And here we come up against a series of obstacles that hamper the searching of the best solution and which nature is concealed just in the features peculiar to the region originating at the past, the national and economic distinguishing characteristics being developed over the long period of time, and it is not so easily to overcome these barriers.

To begin with the market, so loudly declared at formation of five sovereign states in the Central Asia, up to now to a greater extent is present in the statements only, and the market existence is predominantly of the declarative nature while the actual realization of it presumes a long and difficult way. In our situation it means that the search for the optimum with particular reference only to the economic categories is of the Utopian nature particularly when it is considered that the cost of the water as the economic resource is not recognized by all states of the region, and it is still treated, possibly at the initial stage of transition to the market, rather symbolically. Moreover, it should be remembered that the agriculture in the whole world is subsidized by the government , and it is rather complicated to prove its efficiency in the context of the economics although everybody understands the vital necessity of it for any country. But there are bound to be some other estimation

criterion since the agricultural industry is one of the most components of the life support system for the human being.

Here, we just address the local peculiarities without regard for which no optimal solutions will be of real and actual value. First, up to the present the most part of population in the Syr Darya Basin is the rural people; this factor should be always kept in mind in case of any comparative economic outlays. In principle, it may be proved that it is more profitable to be engaged in some other trades or to resettle the people to some other localities, but as of now, all this is the Utopia, and while considering the advantages and shortcomings of different versions in combining the interests of the hydropower sector and irrigated farming, it is well to bear steadily in mind that the most part of the region's population now (and for a long time in the future) will be concerned with the farming which is unthinkable and inseparable of irrigation. Thus, any and the most compelling proof of non-profitability of the agricultural production will be to no avail since the interests and occupation of the most part of population is the historical evidence to be reckoned with. And this is that case when not everything can be estimated through economic calculations. Considering the fact that the majority of the population in the Syr Darya basin is involved in the agricultural farming, the lack of water implies the loss of the livelihood.

The second, no less important factor is, over the period of twenty last years, the challenge of the most critical importance in the Central Asia the acuteness of which is still growing - the drying of the Aral Sea; it is evident that solution of this urgent problem of the global scale depends directly on the Amu Darya and Syr Darya Rivers flows. In regard to the Syr Darya River, it should be noted that the preferential consideration of the hydropower sector interests can only aggravate the situation because in such case the volume of the river flow will drastically increase during the nongrowing season (more than by 2-3 times), however under conditions of the freezing of the Syr Darya lower reaches and artificial barriers along its channel downstream Kzyl-Orda the specified water won't come to the Aral Sea but first of all it will flood the irrigated areas of the Kzyl-Orda Oblast causing damage to the lands themselves and making inoperative the irrigation systems, collector and drainage networks and the water management infrastructure on the whole. The second consequence of the power regime is far well known to be detailed: it is concerned with the discharges to the Arnasai depression from the Chardara reservoir. Much was already said about the adverse impacts of the above-mentioned discharges but here we indicate the major fact in the context of the Aral Sea challenge - the water will be lost not for its practical application but, and this is the most essential, the water is lost for the Aral Sea and the Aral Sea coastal region. It should be recalled that the introduction of the targeted by the regional water strategy of the Aral Sea Basin program for the water saving up to 2010 can actually save, in the Program authors' opinion, the water resources in the order of 5-8 km^3 by the Basin as the whole (that is, by the Amu Darya and Syr Darya Rivers taken together). And this will occur, according to the claim of the strategy developers, when spending enormous expenditures - primarily, the construction costs and technological costs... Meanwhile, only as to the Syr Darya River, since 1993 and annually because of the interdepartmental non-coordination to the Arnasai depression there are discharged from 1 to 9 km^3 of the Syr Darya water in the course of the water year; up to the

present in total there are already discharged 23.9 km^3 or in average 3.5 km^3 during the year, that is from 45 to 70% of the hypothetical economy from the water saving by the whole Aral Sea Basin to gain which it's possible only in case of enormous spendings and massive efforts. May be it is worthwhile to expend considerably less forces and financial resources and to eliminate the losses which over the whole period of the Chardara hydrosystem operation up to 1993 took place only in 1969 - the catastrophically high-water year, especially as the way for this problem solution is well known and was regularly practiced before 1992 in the course of many years running.

It is self-evident that the account must be taken of the present-day realities: existence of the independent states, different-directed interests and potentialities reduced in the consequence of the economic recession, the market system being formed in the region accompanied by the economic independence of many departments, the being observed from time to time peculiar interpretation of the international water law as well as not always fulfilled interstate and intergovernmental agreements on the Syr Darya Basin water and power resources use. This will allow to arrange the deliveries effectively, to stabilize the Naryn-Syrdarya Reservoirs Cascade operation and by doing so to ensure the Syr Darya water rational use which could mean maintenance of the life itself for millions of people residing along the banks of the Syr Darya River, and strengthening the normal relations between the new states of the region. It is impossible to estimate through any money the both results gained.

Thus, in summary one can arrive to the following conclusions:

1. All states-the water consumers of the Syr Darya Basin are liable to coordinate and sign in good time the intergovernmental agreements on the rational use of the Basin's water and power resources but first and foremost - to fulfill punctually the stipulated in them their obligations since without this it is not feasible to attain the optimal use of the tight water resources.

   The emphasis in the agreements should be placed on supplying through the compensation deliveries the heat and water resources to the Kyrgyz Republic, accumulating the water in the Toktogul reservoir therewith giving the main stress on the reduction of the autumn-winter releases but not making efforts only to increase them during the growing season since only in this case the Toktogul reservoir will be maintained as the long-standing regulator of the Naryn-Syr Darya flow. The volume of the nonvegetative releases should not exceed 5-6 km^3 to avoid the water discharges to the Arnasai depression. In this case it is possible to attain the non-admittance of the inflow to the Chardara reservoir in volume more than 11 km^3 that, at all other factors being equal, (the release from the reservoir is no more than 7-8 km^3 and during the growing season the reservoir is drawn down up to the dead storage) will provide a possibility to operate without the water losses.

   In summer the volume of the releases from the Toktogul reservoir should be no less than 6.5 km^3 during the normal water year, at least 7.5 km^3 during the low - water years and 3-4 km^3 in the low-water years.

2. It is required to continue the rearrangement of the Kairakkum reservoir operation that was started during the last intervegetation period of 1998-1999 water year. In the course of the first 1.5-2 months of the nongrowing season (October-November) the releases should be the maximum ones in order to form the reserve storage in the reservoir bowl for the subsequent two thirds of the period when the Toktogul's releases will increase. This will enable to load the HPP's turbines during practically the whole nongrowing season and to reduce the no-load releases during the second half of the nongrowing season.
3. Accordingly, throughout October and during the first half of November the releases from the Chardara reservoir should be at least 600-700 m^3 to guarantee the maximum water supply to the Aral Sea and the Aral Sea coastal region and to succeed in formation of the maximum dimension of the so called «ice pie». There should be provided the volume of the nonvegetative releases from the Chardara reservoir of no less than 7-8 km^3.
4. The observance of the conditions listed in items 1 - 3 will make it possible to eliminate or drastically reduce the nonproductive water losses and to guarantee the water supply to the Aral Sea and Aral Sea coastal region.
5. To the beginning of the nongrowing season the channel reservoirs should be emptied, and as to the Kairakkum reservoir it is required to solve the problem concerning the influent channel clearing up for the water intake by the Makhram pumping station.
6. Taking into consideration that the states of the region are entering the world market system, the more widespread approach should be applied when tackling the problems and we shouldn't restrict ourselves only to the interrelations of the states, which interests are directly touched in the certain case.
7. The matter of implementing the compensation deliveries for the non-used water and non-generated electric power which are still the most significant means to reconcile and mitigate the interdepartmental and interstate contradictions depends upon the efficient introduction of the market relations in the countries of the region. Since the conditions are dictated by the economy, the flows of the resources should be directed towards the places of mutual interests and common striving to gain the maximum benefit - thus, the market itself specify the procedure and the most profitable way of actions. May be it is required to buy the gas from Turkmenistan for the needs of the Bishkek heat and power station. As it is known, the gas transportation is more profitable than the coal carriage. It is possible to generate the electric power at the sites of the coal mining or the gas production and to transfer it through the looped power grid of the region. Therewith, there should be taken into account the interests of the countries through which territories the gas is transported and the electric power is transferred. During the growing season it is required to search for a buyer of the electric power generated by the Toktogul hydrosystem. The purchase and sale of the thermal power resources, the search for the most beneficial trends and regime for making the transactions - all this at the properly arrangement of work will allow to start up the compensation mechanism that in the course of the last years is malfunctioning. It is worth to be repeated that the market makes it possible to find some other ways and few steps in that direction have been already made - for example, Kazakhstan supplied the electric power to the Talas Oblast of

Kyrgyzstan, the BVO proposes to attract the underemployed capacities of the Mary regional hydroelectric power plant, there are also some other ways for tackling the problem.

8. The most important and at present being poorly solved problem is the following: the non-readiness of the Syr Darya channel downstream the Chardara reservoir for releases of the increased volumes of water to the Aral Sea, therewith until very recent times the restrictions were in force both during the ice formation period below Kzyl-Orda and during the growing season since there exists the Aitek hydrosystem with the maximum throughput capacity of 400 m^3/s but actually it is less. Therewith, during the last growing season even the increased summer releases from the Chardara reservoir (up to 1,000 m^3/s and more) didn't allow to increase radically the water supply to the Aral Sea. In the first quarter of this year the problem of the Aitek hydrosystem was taken from the agenda. The solution of some other problems in the specified direction such as the preparation and clearing up of the channel in the Syr Darya lower course, reconstruction of the systems downstream the Chardara reservoir and of the irrigation systems in the lower reaches - this is the way to the actual increase of the water supply to the Aral Sea.

Annexes

ASSESSMENT OF THE CURRENT STATE OF THE ARNASAI LAKES AND POTENTIAL CHANGES IN THE HYDROMETEOROLOGICAL REGIME

As for now, the Arnasai is the largest lake system in the Republic of Uzbekistan. These lakes were formed in the catastrophically high-water year of 1969 as the consequence of the water discharge in the volume over 21 km^3 from the Chardara reservoir. The area of the lake system amounts to 2,000 km^2. During the subsequent 10 years the water elevation in the lakes was decreasing, and by 1978 the water level has decreased by 5 m. With the purpose of preserving the biological potential of the water bodies, at that period the reconstruction of the lake system was commenced. There were constructed the dam and the outlet conduit between the Aidar and Tuzkane Lakes, the building of the feeding canal was commenced and there was improved the roads infrastructure.

By the early 90-ties the water level was at the elevation mark about 237 m. abs.

The recommenced since 1993 releases from the Chardara reservoir associated with the Toktogul reservoir operation in the power regime, low throughput capacity of the Syr Darya River channel in its lower course particularly during the period of the ice formation have led to the radical rearrangement of the Arnasai lakes regime.

Volumes of the Water Releases from the Chardara Reservoir to the Arnasai Lakes Over the Period of 1993-1998 (mln. m^3)

Year/ month	I	II	III	IV	V	VI	E km^3
1993			1390	241.83		1018.65	2.650
1994	2281.6	3217.54	2619.48	982.37	184.81		9.286
1995	1044.58	2063.58	894.58				4.003
1996			1207.96				1.208
1997		762.05	482.11				1.244
1998		171.76	1936.48	108.86		917.57	3.135
TOTAL							21.436

The total rise of the water level by July 1998 came to 6.4 m as compared with January 1993. The water elevation reached 224.02 m. Therewith the total area of the newly flooded lands run to 1,074 km^2.

This terminated in failure of the dam and the spillway facility between the Aidar and Tuzkane Lakes, breakdown of the highway bridge over the Eastern-Arnasai lakes, flooding of the wells, shipyards, motor roads and fishermen camps.

According to the data of the specialized expeditionary survey of the lakes, the Institute *SANIGMI* of the Main Hydrometeorological Department of the Republic of Uzbekistan revealed that by November 1998 the water level in the lake amounted to 243.7 m, the lake's area - 3,039 km^2 and the water volume - over 31 km^3. The analysis of the 1993-1998 data has indicated that the annual level variations range from 0.8 to 2.3 m. In the winter-spring period through discharges from the Chardara the water level raises proportionally to the releases volumes. The maximum levels were observed in May. In the summer-autumn period at the maximum evaporation the water level drops by 0.5-0.7 m.

On the basis of the estimates performed at different variants of the regime for the Chardara reservoir water releases, it is determined that the annual discharges from the reservoir in the volume less than 1.5 km^3 will cause the slow contraction of the lake system. Under conditions of the releases stoppage from the reservoir the water level in the lakes during the first three years will be decreasing by 0.4-0.6 m per year. And then the intensity of the level drop will reduce, and in prospect the water level will stabilize at the elevation about 238 m. At this variant by the year of 2000 the water elevation in the Arnasai lakes will reduce to 242.2 m. abs., and the area of the dried lake bed will come up to 262 km^2.

The releases from the Chardara reservoir exceeding 1.5 km^3 will lead to the flooding the new pasture territories. Every subsequent cubic meter of the water will increase the water level by 0.2-0.3 m and flood 50-70 km^2 of the areas.

The formation in the desert zone of a large water body and the drastic changes in its dimensions influences the environment conditions and first of all the Hydrometeorological regime, the ground waters regime, the salts migration as well as the soils, plants and landscapes conditions.

The adverse effects of the sharp changes of the water levels in the lakes is connected not only with the flooding of new territories, disruption of the infrastructure and location of the water management facilities. In case of the subsequent drop in the flooding, as a consequence of the bank's reforming and their salinization the dried beds of the lakes could hardly be recultivated. Thus the territories that came under flooding for a long period of time wouldn't be effectively used in the water management activities.

With the advent of the sovereignty the Kyrgyz Republic, reasoning from its own needs, has brought the winter flow of the Naryn River up to 7.5-8 km^3 as compared with the natural flow of 3-3.5 km^3, and this water discharge rate became as if the permanent one; at the same time , since that period there were commenced the operating water discharges to the Arnasai.

This led to the situation that on the territory of the Republic of Uzbekistan there were flooded 130,000 ha of the pastures, this process is still in progress, and it is still a question how it will end. About 27 km^3 of water have been discharged to the Arnasai over this period, or about two annual flows on the Naryn River.

It should be noted that it became the constant factor that from January 1 to April 1 the water in the guaranteed volume of 7.5-8.5 billion m^3 enters the reservoir every year: in 1997 - 7.6 billion m^3 , in 1998 - 8.8 billion m^3, before March 15, 1999 -

6.6 billion m^3 at the volume of the Chardara reservoir including the dead storage of 5.5 billion m^3 , so it not required to convince that there is a permanent guarantee for ensuring the reservoir's filling up, and due to it there is no necessity to fill it up before December 1 instead of continuing its drawdown while still warm and before the freeze-up of the river.

By September 1, 1997 in the reservoir there were about 700 mln. m^3 of water, and by September 1, 1998 there were remained 2,300 mln. m^3 instead of the water drawdown in August.

Rather then deliver large flow rates to the river in August and then in September-October while still warm, actually there was set up another regime for the releases.

In September the water discharge to the river was 1,282 mln. m^3, in October - 1,369 mln. m^3 and in November - 1,500 mln. m^3 . In case in September-October the discharge rate was at the level as it was in November, the water discharge to the river would be greater by 500 mln. m^3.

This situation is even more aggravated by the fact that the Republic of Kazakhstan doesn't fulfill its obligations on transfer of the electric power and return in the winter period of the equivalent volume of the energy carriers in conformity with the Interstate Agreement On the Joint and Complex Use of the Water and Power Resources of the Naryn-Syrdarya Reservoirs Cascade.

As a consequence of it, in October-December 1998 and January-March 1999 the water releases from the Toktogul reservoir amounted to the volume by 1 billion m^3 more than it was stipulated by the regime approved by the ICWC decision.

Because of these factors the situation has emerged when already since January 4, 1999 the water discharges to the Arnasai were commenced and in consequence of this during the period of only 2.5 months the volume of the discharged water amounted to 3,085 mln. m^3, the water elevation has catastrophically raised by 105 cm, and in addition there were flooded 19,200 ha of the pastures. There is also created the threat of the flooding of the high-voltage transmission line towers and of the motor roads.

In the context of the developed water management situation and considering the aforesaid, the following suggestions have been put forward:

1. During the autumn-winter periods the Toktogul reservoir would operate in the power regime, and the changes of this regime are not anticipated.

2. There are sufficient constant guaranteed water resources (for January-March) for the guaranteed filling up of the Chardara reservoir. Since August to

January 1 it is not required to accumulate water in the reservoir and while it is possible it should be necessary to discharge the water to the river in the maximum volume. The water accumulation should be commenced since January 1.

Head of the
Water Resources Balance Department (signature) B. Yusupov

WATER RESOURCES USEIN THE SYR DARYA RIVER BASIN OVER 1995-1998 WATER YEARS

Table 1

##	Administrative unit	Years	Total volume of Syr Darya water used, km^3		Water distribution among the water consumers, km^3					Notes
			Total	Incl. From the channel	Irrigated Agriculture	Municipal utilities	Industry		Others	
							for the whole sector	Incl. the circulating water supply		
1	Andizhan	1995-96	3154	650.8	2857.7	103.9	31	41	190.6	
		1996-97	3380.7	851.4	3064.9	109.8	31	41	203.8	
		1997-98	3191.8	776.3	2889.9	105.3	31	41	195.7	
2	Namangan	1995-96	3081	2183.4	2916.6	70.1	98	20.8	88.4	
		1996-97	2878.8	2120.6	2725.3	77.3	98	20.8	66.5	
		1997-98	3443.4	2428.8	3308.6	33.2	98	20.8	91.7	
3	Fergana	1995-96	4702	2642	4238	40	157	896	40.1	
		1996-97	4302	2217	4006	40	157	896	40.5	
		1997-98	4123	2507	3813	25.4	157	896	35.7	
4	Tashkent	1995-96	6926.5	693.4	3827.1	2108.9	2257	2104	380.1	
		1996-97	7376.3	580	4401.3	2020.8	2257	2104	327.9	
		1997-98	7226.9	734.5	4186	2132	2257	2104	409.9	
5	Dzhizak	1995-96	2228.6	1698.2	2208.6	20	12	2.5	23	
		1996-97	2772.1	2358	2747.1	25	12	2.5	21.6	
		1997-98	3061.5	2352.1	3616.5	45	12	2.5	22.8	
6	Syrdarya	1995-96	2683	2475	2479	113	70	17.6	15	
		1996-97	2698	2457	2549	105	70	17.6	7	
		1997-98	3687.4	3531	3526.7	117	70	17.6	8	
	Total by the	1995-96	22775.1	10342.8	18527	2455.9	2625	3081.9	737.2	
	Republic	1996-97	23407.9	10584	19493.6	2377.9	2625	3081.9	667.3	
		1997-98	24734	12329.7	21340.7	2457.9	2625	3081.9	763.8	

WATER RESOURCES USE
IN THE SYR DARYA BASIN OVER 1995-1998 WATER YEARS

Table 2

##	Administrative unit	Years	Irrigated area thous. ha		The irrigating water supply, mln m^3						Efficiency of the system	WUE during the growing season	Note
					Total during the water Management year		Nongrowing season		Growing season				
			Total	Incl. from channel	Total	Incl. from channel	Total	Incl. from channel	Total	Incl. from channel			
1	Andizhan	1995-96	286.2	109.2	2957.7	596.5	424.8	154.5	2432.9	415	0.66	1	
		1996-97	284	109.3	3064.9	732.2	695.8	257.2	2369.1	475	0.66	1	
		1997-98	277.6	104.9	2889.9	667.6	570.6	199.3	2319.3	468.3	0.66	1	
2	Namangan	1995-96	275.5	195.2	3081	2183.4	538.2	377.4	2542.8	1806	0.64	0.96	
		1996-97	274.8	194.8	2878.8	2120.6	649.6	460.2	2229.2	1660.4	0.64	0.96	
		1997-98	274.7	195.8	3443.4	2428.8	604.5	430.3	2838.9	1998.5	0.64	0.92	
3	Fergana	1995-96	360	221.1	4238	2642	1184	983.7	3054	1558	0.65	0.97	
		1996-97	360	221.1	4006	2217	1174	916	2832	1301	0.65	0.98	
		1997-98	360.2	221.1	3813	2507	946	898	2867	1608	0.65	0.97	
4	Tashkent	1995-96	385.4	35.7	3827.1	601.6	198.5	64	3628.6	537.6	0.66	0.98	
		1996-97	385.4	35.7	4401.3	514.3	247.3	41.5	4154	472.8	0.66	0.98	
		1997-98	385.4	35.7	4186	643.6	371	41	3815	602.6	0.66	0.98	
5	Dzhizak	1995-96	288.7	232.8	2208.6	1688.2	435.1	321.6	1773.5	1366.6	0.8	0.95	
		1996-97	289	234.8	2747.1	2343.2	575.1	513.2	2172	1830	0.8	0.96	
		1997-98	289.3	232.7	3016.5	2530.8	1505	959.7	1961.5	1570.1	0.8	0.95	
6	Syrdarya	1995-96	288.9	288.9	2479	2475	548.5	549	1931	1931	0.77	0.96	
		1996-97	286.6	286.6	2549	2457	958	1004	1591	1637	0.77	0.96	
		1997-98	290.9	290.9	3526.7	3531	1102.4	1102.4	2424.3	2428.3	0.77	0.94	
	Total by the Republic	1995-96	1884.7	1082.9	18691	10159.7	3329.1	2450.2	15362.8	7614.2	0.64	0.97	
		1996-97	1879.8	1082.3	19647	10384.3	4299.8	3192.1	15347.3	7376.2	0.64	0.97	
		1997-98	1878.1	1081.1	20876	12308.8	5099.5	3630.7	16226	8675.8	0.64	0.96	

DATA ON THE LANDS USE AND PRODUCTIVITY

Table 3

##	Administrative unit	Years	Yield capacity, centner/ha					Areas excluded from agricultural rotation thous. ha	Reasons for exclusion of the lands from rotation
			Cotton	Rice	Fodder crops	Vegetables & melons	Others		
1	Andizhan	1995-96	28.7	33.1	405.1	220.1	48.5		
		1996-97	30.1	33.5	428	223.7	58.3		
		1997-98	24.3		430	225.5	66.5		
2	Namangan	1995-96	28.75	22.65	362	262.2	38.4		
		1996-97	27.65	21.2	247	265.4	33.7		
		1997-98	25.5		261	251	34.5		
3	Fergana	1995-96	23.6	25	112.4	156.8	96.6		
		1996-97	29	26.6	170.6	170.6	127.3		
		1997-98	22.8		108.2	174.7	123.6		
4	Tashkent	1995-96	24.7	34.5	164.7	162.75	78.5		
		1996-97	22.9	33.5	161.9	175.3	81.9		
		1997-98	20	33	188.4	172.2	83.7		
5	Dzhizak	1995-96	18.9	25	112.9	178.95	95.6		
		1996-97	12.6	20.6	145.8	90.45	98.7		
		1997-98	15.1	30.5	95.5	76	104.3		
6	Syrdarya	1995-96	21.2	19.8	25	94.75	49.2		
		1996-97	14.2	22.9	24.3	75.45	55.4		
		1997-98	14.4	20	23.4	76.35	45.6		
	Total by the Republic	1995-96	24.3	26.7	197.0	179.3	67.8		
		1996-97	22.7	26.4	196.3	166.8	75.9		
		1997-98	20.4	13.9	184.4	162.6	76.4		

DATA ON THE LANDS USE AND PRODUCTIVITY

Table 4

##	Administrative unit	State of the land reclamation thous. ha			Technical state of hydrotechnical facilities, In % of the total volume			Technical state of collector-drainage system facilities, in % of the total volume		
		Good	Satisfactory	Unsatisfactory	Routine repair is required	Major repair is required	Reconstruction or rehabilitation is required	Routine repair is required	Major repair is required	Reconstruction or rehabilitation is required
1	Andizhan	82.8	172.2	14.3	100	53	16	32	22	8
2	Namangan	211.6	56.5	9.5	100	60	18	34	23	7
3	Fergana	61.5	260.2	16.7	100	53	18	36	23	9
4	Tashkent	342.1	37.9	8.7	100	50	16	31	22	9
5	Dzhizak	52.1	224	6	100	51	20	22	20	10
6	Syrdarya	211.6	234.4	53.8	100	58	20	33	24	10
	Total by the Republic	961.7	985.2	109	100	54	18	31	22	9

WATER RESOURCES USE IN THE SYR DARYA BASIN OVER 1995-1998 WATER YEARS
(Republic of Tajikistan)
Final Statement

Table 1

##	Administrative unit	Years	Total volume of Syr Darya River water used, km^3	Distribution of water among the water consumers, km^3					Notes
				Irrigation Farming	Municipal Utilities	Industry		Others	
						for the whole Sector	incl. the circulating water supply		
1	Leninabad Oblast*	1995	2.3035	2.0565	0.205	0.030	-	0.012	
		1996	2.3758	2.0028	0.309	0.045	-	0.019	
		1997	2.3321	2.0011	0.271	0.047	-	0.013	
		1998	2.5265	2.1305	0.327	0.048	-	0.021	

WATER RESOURCES USE
IN THE SYR DARYA BASIN OVER 1995-1998 WATER YEARS
(Republic of Kazakhstan)
million m^3

Administrative Unit	Years	Total Water Withdrawals	Water Allocation Between Economic Sectors		
			Irrigation Farming	Municipal Sector	Industry
Kzyl Orda Oblast and South Kazakhstan Oblast	1995	9,415.1	8, 633.3	123.8	187.4
	1996	9,603.8	8,387.3	128.0	125.9
	1997	8,734.6	7,795.9	113.6	126.9
	1998	9,270.8	7,077.6	97.7	77.1

WATER RESOURCES USE
IN THE SYR DARYA BASIN OVER 1995-1998 WATER YEARS
(Republic of Tajikistan)
Final Statement

Table 2

##	Administrative Unit	Years	Irrigated area, thous. ha	The irrigating water supply, mln. cu. M			Efficiency of the system	Water use efficiency - WUE (during the growing season)	Notes
				Total over the water Year	Nongrowing Season	Growing Season			
1	Leninabad Oblast*	1995	242.59	2,056.5	225.09	1,831.41	0.72	in average - 0.7	
		1996	254.08	2,002.8	212.57	1,790.23	0.71	in average - 0.7	
		1997	235.21	2,001.1	213.48	1,787.62	0.69	in average - 0.7	
		1998	250.98	2,130.5	223.71	1,906.79	0.68	in average -0.7	

Efficiency of the Irrigation System
(Republic of Kazakhstan)

Administrative Unit	1995	1996	1998	
Kzyl Orda Oblast	0.60	0.60	0.58	
South Kazakhstan Oblast	0.60	0.59	0.57	

DATA ON THE LANDS USE AND PRODUCTIVITY
(Republic of Tajikistan)

Table 3

##	Administrative Unit	Years	Yield capacity, centner/ha					Areas excluded from agricultural Rotation thous. ha	Reasons for exclusion of the lands from rotation
			Cotton	Rice	Fodder crops	Vegetables & melons***	Others****		
1	Leninabad Oblast*	1995	17.2	18.1	472.8	184/80	22.6	-	-
		1996	16.1	17.2	482.3	165/81	19.1	-	-
		1997	15.8	16.9	493.5	158/79	18.5	-	-
		1998**							

DATA ON THE LANDS USE AND PRODUCTIVITY
(Republic of Kazakhstan)

Crops	Productivity (centner/ha)			
	1995	1996	1997	1998
Kzyl Orda Oblast				
Rice	25.8	36.7	40.4	40.3
Winter wheat	8.3	3.0	13.3	10.8
Spring wheat	6.1	6.5	7.8	8.8
Maize	13.0	9.3	24.2	19.9
Alfalfa	28.3	27.7	29.3	28.1
South Kazakhstan Oblast				
Cotton	21.6	17.8	19.2	14.1
Rice	15.2	16.3	15.1	19.7
Winter wheat	9.2	14.0	14.0	11.8
Maize	17.6	14.0	16.9	25.0
Alfalfa	31.0	25.0	20.1	19.4

SUPPLEMENTARY DATA
(Republic of Tajikistan)

Table 4

##	Administrative Unit	Years	State of the land reclamation, ha		Technical state of hydrotechnical facilities, in % of the total volume			Technical state of collector-drainage system facilities, in % of the total volume		
			Satisfactory	Unsatisfactory	Routine repair is required	Major repair is required	Reconstruction or rehabilitation Is required	Routine repair is required	Major repair is required	Reconstruction Or rehabilitation is required
1	Leninabad Oblast*	1995	49.08	19.59	70	62	15	32	24	12
		1996	39.4	29.1	82	70	18	38	26	15
		1997	40.4	32.8	86	73	20	41	29	20
		1998	50.9	39.2	89	75	21	43	31	22

*) The data have been presented only by the Syr Darya Basin (without regard for the Zarafshan River Basin which also refers to Leninabad Oblast) over 1995-1998 water year.

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